NON-PUBLIC?: N
ACCESSION #: 8903060032
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Catawba Nuclear Station, Unit 2 PAGE: 1 OF 9

DOCKET NUMBER: 05000414

TITLE: Manual Reactor Trip Due to Decreasing Steam Generator Level Because of An Equipment Malfunction
EVENT DATE: 01/21/89 LER #: 89-002-00 REPORT DATE: 02/20/89

OPERATING MODE: 1 POWER LEVEL: 021

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv) and 5072(b)(2)(ii)

LICENSEE CONTACT FOR THIS LER:
NAME: Julio G. Torre, Associate Engineer-Licensing TELEPHONE: 704-373-8029

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: TJ COMPONENT: TT MANUFACTURER: F120
REPORTABLE TO NPRDS: N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On January 21, 1989, at 1848:40 hours, the Unit 2 reactor was manually tripped due to decreasing level in Steam Generator (S/G) B. This transient was initiated by the mechanical malfunction of a temperature transmitter for the Generator Stator Cooling Water (KG) System. The failed transmitter caused 2KG5, Generator Stator Cooling Temperature Control Valve, to remain open, bypassing the heat exchanger. This resulted in a turbine runback on high KG temperature. Turbine runback was terminated automatically at approximately 1838 hours. During the subsequent transient, the S/G levels began a large oscillation. The Main Feedwater Pump Turbine (CFPT) discharge pressures began rising due to CF Regulating Valves closing in response to increasing S/G levels. To gain quicker response of CFPT 2A speed control, the Balance of Plant Operator swapped from the Westinghouse to the GE controller. This swap was performed with a deviation between the two controllers. CFPT 2A and CFPT 2B tripped on Hi Discharge Pressures. Control of the CFPTs could not be regained. As S/G B level was decreasing towards the Lo Lo Level setpoint, the Reactor was manually tripped at approximately 21% power. Prior to this incident, the Unit was operating at approximately 95% power. This incident

has been attributed to an equipment malfunction. The linkage from the temperature bellows to the transmitter bellows was loose. The linkage was tightened and a sealant was applied. The transmitter was calibrated and placed back in service.

Additional simulator training on swapping from Westinghouse to GE controllers will be provided. The health and safety of the public were unaffected by this event.

END OF ABSTRACT

BACKGROUND:

The Generator EIIS:GEN! Stator Cooling Water EIIS:TJ) (KG) System provides low conductivity cooling water to the Generator Stator, Exciter EIIS:EXC! Power Rectifiers, EIIS:RECT! and Generator Bushings. The system is equipped with 2, 100% capacity heat exchangers EIIS:HX!. Flow to these heat exchangers is controlled by 2KG5, Generator Stator Cooling Water Temperature Control Valve EIIS:V!, to maintain stator cooling at approximately 114.8 degrees F inlet. If stator cooling water temperature reaches 183 degrees F, an automatic Turbine EIIS:TRB! Runback is initiated which reduces generator output to approximately 23% Turbine rated load.

The Main Feedwater EIIS:SJ! (CF) Pump EIIS:P! Turbines (CFPTs) interface with Westinghouse 7300 Process Control Equipment and General Electric (GE) Controllers. The present Operator interface for the two CFPTs consists of 5 manual/auto (M/A) stations. Three of these M/A Stations provide control through the 7300 Process System; one for each Turbine and a third for balance (i.e. offset) between the two Turbines. The two remaining M/A Stations provide direct manual input to the GE Control System for the Turbines. The GE Controllers are normally used to start the CFPTs, and the Westinghouse Controller is used for speed greater than 2975 rpm and below 5620 rpm. When transferring controllers, the CFPT Deviation Meter must be adjusted to zero. If a deviation exists, the CFPT speed will increase/decrease to the setting of the potentiometers.

DESCRIPTION OF INCIDENT:

On January 21, 1989, Unit 2 was operating at approximately 95% power. At 1817:14 hours, a Hi Generator Stator Cooling (KG) Inlet Temperature alarm was received in the Control Room. The Unit Supervisor and an Operator went to the KG Panel to investigate the alarm at approximately 1820 hours. At approximately 1830 hours, the oncoming shift was arriving from shift turnover. The KG Stator Water Temperature signal increased to 183 degrees F which

automatically initiated a Turbine Runback at 1835:23 hours. At approximately 1836 hours, all the Condenser EIIS:COND) Steam Dump valves opened and closed as appropriate except for the following:

SB15 (Bank 2) which opened and closed at Bank 1 setpoint,

SB6 (Bank 2) which opened on initial Tave-Tref deviation but not on subsequent deviation,

SB21 (Bank 3) which did not indicate full open.

At 1836:27 hours, the Low Bank Insertion Limit alarm was received as expected in the Control Room. This was due to the automatic rod EIIS:ROD! insertion to bring Tave down to Tref. At 1836:37 hours, the Control Bank Technical Specification Insertion Limit alarm was received. Bank 4 of the Atmospheric Steam Dumps opened as required at 1836:59 hours, with the following exceptions:

SV30 and SV32 which stayed open after Tave-Tref decreased to < 10 degrees F. The Operator at the Controls (OATC) had to manually isolate the SV valves. The SV30 valve indicated closed prior to Reactor trip per Transient Monitor indication. The SV30 Operators Aid Computer (OAC) point did not function. In addition, the SV34 OAC point did not function.

At 1837:53 hours, the Hi Generator KG Temperature alarm cleared. At 1838:03 hours, the Turbine Runback was automatically terminated as designed. Reactor power was approximately 51%. A CRO began emergency boration per the Abnormal Procedure at 1838:22 hours, due to the Control Bank Technical Specification Insertion Limit alarm. Emergency boration was terminated at 1838:50 hours. During this Turbine Runback transient, the Steam Generator EIIS:SG! (S/G) levels began a large oscillation. At 1839:41 hours, Main Feedwater Pump Turbine (CFPT) 2A went into recirculation due to S/G levels increasing to near 78% Narrow Range Hi Hi (P-14) Level setpoint causing the CF Regulating Control valves to almost close. The Shift Supervisor (SS) instructed the Operator at the Controls (OATC) and the oncoming OATC to take manual control of all S/Gs. Also, the CROs placed the Steam Dump valves in the pressure control mode. The BOP was instructed to maintain CFPT Steam Pressure/Feedwater Pressure constant. CFPT 2B went into recirculation at 1841:43 hours, due to low flow. The Control Bank Technical Specification Insertion Limit alarm cleared at 1842:51 hours. The SS directed the BOP to back one of the CFPTs out of the header as directed in the Abnormal Procedure. S/G levels were still increasing to near P-14 but were being maintained below the Hi Hi Level setpoint. With S/G level control in manual and steam dumps in pressure

control mode, the BOP began manually reducing CFPT 2B speed. At 1845:09 hours, the Control Bank Technical Specification Insertion Limit alarm cleared but went into alarm again at 1845:51 hours. The CFPT discharge pressures began rising at 1846:57 hours, due to CF Reg valves closing in response to increasing S/G levels.

In an attempt to gain better control at the low CF flow condition, the BOP asked the SS if the CFPTs could be placed in alternate control (GE) instead of Westinghouse control. The GE Controller provides a quicker response of CFPT speed. The SS agreed to this manipulation. The BOP began transferring control mode of CFPT 2A. Due to a deviation of approximately -.5 between the two controllers, the CFPT 2A speed increased and tripped on Hi Discharge Pressure at 1847:19 hours. Also, the Events Recorder indicated CFPT 2A was manually tripped from the Control Room at 1847:25:767 hours. The BOP and those observing him have no knowledge of this occurring. Numerous other Event Recorder malfunctions were also noted. This Events Recorder point was checked on January 22, 1989, by manually tripping CFPT 2A. This indication is being further evaluated by Maintenance Engineering Services. Due to loss of this pump, at 1847:33 hours, the BOP began manually increasing CFPT 2B speed while resetting CFPT 2A. S/G levels were decreasing to the Lo Lo Level setpoint. At 1847:33 hours, CFPT 2B tripped on Hi Discharge Pressure and was reset at 1847:38 hours. The BOP could not regain control of the CFPTs. Observing S/G levels decreasing, the SS directed the CROs to manually trip the Reactor. At 1848:40 hours, the Reactor EIIS:RCT! was manually tripped. The Turbine tripped on Reactor trip at

approximately 1848:41 hours. At 1848:41:581 hours, S/G B Channel 4 Lo Lo Level signal was received. Reactor power was at approximately 21%. At 1848:42:549 hours, S/G B Channel 3 Lo Lo Level Reactor Trip signal was received which satisfied the logic to automatically start Motor EIIS:MO! Driven Auxiliary Feedwater EIIS:BA) (CA) Pumps 2A and 2B. S/G Blowdown EIIS:WI) (BB) and Nuclear Sampling (NM) Isolation occurred. The following valves did not indicate closed during the isolation: 2NM221A, 2NM197B, 2NM211B and 2BB010B. At 1848:49:507 hours, S/G 2C Lo Lo Level Reactor Trip signal was received which satisfied logic to automatically start the Turbine Driven Auxiliary Feedwater Pump (CAPT). At 1848:59 hours, a Feedwater Isolation actuated as expected, as a result of the Reactor Trip with Low Tave. At approximately 1850 hours, the CROs entered the Emergency Procedure for a Reactor Trip and began stabilizing the Unit. Subsequently, the CROs secured CAPT and reset the CA autostart. Instrumentation and Electrical (IAE) Technicians investigated the cause of the Hi Generator KG Inlet Temperature alarm. IAE found the linkage from the temperature bellows to the transmitter bellows EIIS:BE! loose on 2KGTT5270, KG Inlet Temperature Control. This had caused the transmitter to sense a lower than actual temperature which caused

2KG5, Generator Stator Cooling Temperature Control Valve, to stay open. This flow path bypasses the KG heat exchangers. IAE retightened the transmitter linkage, applied a sealing compound to the linkage, and calibrated the transmitter using Work Request 42545 OPS.

On January 22, 1989, at 0835 hours, the CROs placed CFPT 2A in service and secured CFPT 2B. The CF valves were aligned and the CF Bypass Control valves were placed in AUTO at approximately 1100 hours. The Reactor Trip Breakers EIIS:BRK! were closed at 1107 hours. The CROs secured CA Pumps 2A and 2B at 1148 hours. BB and NM isolation valves were also realigned by the CROs. At 1405 hours, the CROs began withdrawing Shutdown Banks. The Unit entered Mode 2, Startup, at 1437 hours. The Reactor went critical at 1505 hours. The Unit entered Mode 1, Power Operation, at 1605 hours.

CONCLUSION:

This incident has been attributed to an equipment malfunction. The linkage from the temperature bellows to the transmitter EIIS:TT! bellows was loose on 2KGTT5270, KG Inlet Temperature Control. This caused the transmitter to sense lower than actual temperature which caused 2KG5, Generator Stator Cooling Temperature Control Valve, to stay open, bypassing the KG heat exchangers. The transmitter was manufactured by Fischer and Porter Company (Model No. 51-1451-TL) IAE repaired, sealed, and calibrated this instrument on Work Request 42545 OPS. A search of the Nuclear Maintenance Data Base shows no previous work being performed on this transmitter which could have affected its function. It was suspected that vibration may have caused the linkage to become loose. Further investigation found that the vibration was within acceptable limits. This transmitter is not presently in the Preventive Maintenance Program. However, Maintenance has a long term goal to include non-safety related balance of plant equipment in this program. In addition, Operations initiated Work Request 42793 OPS to verify setpoints of both Turbine Runback thermostats, 2KGTS5110 and 2KGTS5290, during the 2EOC2 Refueling Outage.

There have been six previous Reactor trips due to equipment failure or malfunction within the past 12 months. Two incidents (LER 414/88-12 and 414/88-13) were due to feedwater valve failures. LER 414/88-7 and LER 414/88-14 involved delamination of pipe coating. LER 413/88-5 and LER 414/88-23 were due to a fuse failure and a failed pushbutton switch. Since none of the above incidents addressed the failure of temperature transmitters, this incident is not considered to be a recurring incident.

Within the past three years, there have been two temperature transmitters identified that were out of calibration. Transmitter malfunctions appear to

be a recurring problem. LER 414/88-31 and Duke Power Incident Investigation Report C86-097-2 identified the Jacket Water Outlet temperature transmitter for Diesel Generator 2A and 2B. The cause of these transmitters being out of calibration was unknown.

The failure of this temperature transmitter is not NPRDS reportable.

During a Design Study of the feedwater problems at Catawba, the CFPT Control System was identified as being complex. It is expected that this system will be changed during 2EOC3 for Unit 2 and 1E0C5 for Unit 1. Until these modifications are made, the additional training provided by the Production Training Services should help to prevent any problems associated with Operator interface concerning the CFPT controllers.

During the transient, the No. 1 seal leak off flow went to zero on Reactor Coolant Pumps C and D for 7 minutes following the load rejection. They recovered briefly when the Reactor tripped but then dropped to zero on NC Pump C for 8 minutes and Pump D for 7 minutes. This is a recurring problem which is being investigated.

The SV and SB valves mentioned in this report have work requests assigned to correct the discrepancies. In addition, NM and BB valves identified in this report were also identified in LER 414/89-01.

It has been observed during the trips of 1/12/89 and 1/21/89 that, following the Reactor trip, charging line flow increases while charging temperature decreases. This is followed by a subsequent decrease in charging flow and concomitant increase in charging temperature. This is perhaps explainable due to the constant heat load assumed to exist with the regenerative heat exchangers. Due to NC Pump seal problems, charging flow does not recover to the same flow value post-trip compared to pre-trip. Upon the subsequent increase in charging temperature, letdown flow begins to oscillate (this oscillation was not seen in the trip of 1/21/89). This oscillation of letdown flow has led to concerns involving potential flashing of letdown flow downstream of the letdown orifice.

CORRECTIVE ACTION:

SUBSEQUENT

(1) Unit Supervisor and an Operator went to the KG panel.

(2) CROs initiated emergency boration per Abnormal Procedure.

(3) CROs took manual control of the S/Gs and placed the steam dumps in pressure control mode.

(4) BOP Operator took manual control of the CFPTs.

(5) CROs manually tripped the Reactor and stabilized the Unit.

(6) IAE investigated/repaired and calibrated the temperature transmitter per Work Request 42545 OPS.

(7) The Hi Generator KG Temperature alarm was reset at 165 degrees F. to allow more time for Operator action prior to initiation of automatic Turbine Runback.

(8) Vibration of 2KGTT5270 was checked by Operations per SWR 6468 and found to be within acceptable limits.

(9) Work Request 42793 OPS was generated to check setpoints of 2KGTS5110 and 2KGTS5290.

PLANNED

(1) Additional simulator training on transferring CFPT controllers from Westinghouse to GE during transients will be provided.

(2) Oconee and McGuire Nuclear Stations will be notified of Catawba's action of lowering the alarm setpoin
to 165 degrees F. for the KG water
temperature to allow more time for Operator action prior to Turbine Runback.

(3) The practice of setting mechanical linkages on controllers/positioners which are subject to vibrations, and the practice of using sealing compounds will be reviewed.

(4) Charging/letdown flow and temperature transient problems described in this report will be evaluated. Corrective actions will be initiated as appropriate.

(5) Responsibility for resolution of all inadequate post-trip responses will be assigned. Duke Power personnel will ensure that all items are identified on the Station Commitment Index.

SAFETY ANALYSIS:

Upon initiation of the Unit Runback signal due to generator stator cooling water high temperature, the Reactor ranback from 95% to 51% full power over a period of approximately 2 minutes and 40 seconds. The automatic runback was terminated upon either a) Stator Cooling Water Temperature alarm reset, or b) generator load approximately equal to 300 MWe. After termination of the runback at 51% power, Reactor power continued to decrease due to manual control rod insertion and boron addition to the Reactor Coolant system.

The Reactor was manually tripped at 21% full power in anticipation of an automatic trip on S/G low-low level. S/G B Low-Low Level Reactor Trip signal occurred approximately 2 seconds after manual Reactor trip. Upon Reactor trip, all of the control rods dropped to the bottom of the core, reducing power to decay heat level. CF Isolation was automatically initiated upon Reactor trip with low Tave (564 degrees F). The CA Pumps did not autostart upon loss of both CF Pumps due to the reset status of the CF Pumps. Both Motor Driven CA Pumps autostarted upon S/G B low-low level, and a Turbine Driven CA Pump Autostart signal occurred approximately 7 seconds later upon low-low level in two-out-of-four S/Gs. The redundant steam supply valves for the Turbine Driven CA Pump, SA2 and SA5, opened within 4 seconds and 10 seconds, respectively, of the autostart signal.

During the Unit runback prior to the trip, Reactor Coolant average temperature decreased from 588 degrees F to approximately 570 degrees F. Reactor Coolant temperature fluctuated prior to the trip due to fluctuations in secondary side steam pressure. Upon Reactor trip, Reactor Coolant temperature decreased to a minimum value of 549 degrees F, and stabilized at the no-load target of 557 degrees F within 30 minutes post-trip. Upon the Unit runback and Reactor Coolant temperature decrease, Reactor Coolant System pressure decreased to a minimum value of 2100 psig, and then recovered to 2230 psig. Upon Reactor trip, Reactor Coolant System pressure decreased to a minimum value of 2100 psig, and stabilized at 2230 psig within 30 minutes post-trip, 5 psi from the no-load target of 2235 psig. Pressurizer EIIS:PRZ! level decreased from 60% to 42% upon Unit runback, and fluctuated until Reactor trip. Upon Reactor trip,

pressurizer level decreased to a minimum value of 21%, and then stabilized at 38% within 30 minutes post-trip, 13% from the no-load target of 25%. Steam pressure fluctuated upon Unit runback prior to the trip, increasing to a value of 1080 psig at the time of Reactor trip. Upon Reactor trip, steam pressure increased to a maximum value of 1110 psig, and stabilized at 1080 psig within 30 minutes post-trip, 10 psi from the no-load target of 1090 psig. S/Gs A, B, C, and D reached a minimum wide range indicated value of 54%, 51%, 53%, and 53%, respectively. Correction of these values for calibration condition

variations yields actual wide range minimum levels of 72%, 67%, 70%, and 70% for S/Gs A, B, C, and D, respectively.

Main Steam Atmospheric Dump Valves SV30 and SV32 opened upon Unit runback, but did not close when Tave-Tref deviation decreased below the closure setpoint. However, the Operator manually isolated these valves. During the Unit runback and subsequent power reduction after termination of the runback, a Control Bank Tech Spec Insertion Limit alarm was generated. At this point, the Operator initiated emergency boration. Reactor Coolant boron concentration was increased from 147 ppm to 155 ppm, adding approximately 130 pcm of negative reactivity.

The Steam Dump to Condenser and Bank 1 of the Atmospheric Dump valves cycled to relieve steam during the Unit runback and prior to the trip. The Steam Dump to Condenser valves cycled to relieve steam post-trip. An adequate supply of auxiliary feedwater was available to remove core decay heat. The Reactor Coolant was 44 degrees F subcooled at the point of minimum Reactor Coolant System pressure. An adequate heat for core decay heat removal was available and maintained at all times.

Prior to the trip, the Unit runback at a rate of approximately 17% per minute. The maximum load change assumed for an operational transient (condition 1 event) is a step load change of up to 10% or a ramp load change of up to 5% per minute. Therefore, the runback portion of this event is bounded by the "Loss of External Load" transient as discussed in Section 15.2.2 of the Catawba FSAR (condition 2 event). Section 15.2.7 of the Catawba FSAR assumes that a) the Unit trips from 102% of ESF design rated power, b) Reactor trip occurs on S/G low-low level, and c) steam is relieved through the S/G Code Safety valves. In this event, the Unit tripped from 21% full power; the Reactor tripped approximately 2 seconds prior to RPS setpoint trip (S/G low-low level); and the Steam Dump -to Condenser valves and the Atmospheric Dump valves were available to relieve steam. Also, the FSAR does not assume CA pump autostart upon loss of both CF pumps, but rather, when the RPS setpoint (S/G low-low level) is reached. In this event, the CA pumps were autostarted upon S/G Low-Low Level signal. Therefore, the Reactor trip portion of this event is fully bounded by the "Loss of Normal Feedwater Flow" transient as discussed in Section 15.2.7 of the Catawba FSAR.

All plant safety equipment was available throughout this event. The cooldown limits of 100 degrees F per hour for the Reactor Coolant System and 200 degrees F per hour for the pressurizer were not exceeded. Integrity of the fuel cladding, Reactor Coolant system, and Containment structure was maintained at all times. The health and safety of the public were not affected by this incident.

This incident is reportable pursuant to 10CFR 50.73, Section (a)(2)(iv) and 10CFR 50.72, Section (b)(2)(ii).

ATTACHMENT 1 TO 8903060032 PAGE 1 OF 1

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February 20, 1989

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Catawba Nuclear Station, Unit 2
Docket No. 50-414
LER 414/89-02

Gentlemen:

Pursuant to 10 CFR 50.73 Section (a) (1) and (d), attached is Licensee Event Report 414/89-02 concerning a manual reactor trip due to decreasing steam generator level because of an equipment malfunction.

This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker

JGT/IIR88

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